What is claimed is:

1. A signal processing device adapted to multiply the N/(2^m) samples obtained by decimating the N samples of a signal by a forward transform window and subsequently perform a linear forward transform on the obtained signal, said device comprising:

a preprocessing means for performing a predetermined preprocessing operation on the signal obtained by the multiplication using the multiplier of said forward transform window;

a transform processing means for performing a processing operation equivalent to a fast Fourier transform on the output signal of said preprocessing means;

a postprocessing means for performing a predetermined postprocessing operation on the output signal of said transform processing means; and

the input signal and the output signal of said transform processing means being complex signals having a length of N/(2^(m+2)).

2. The signal processing device according to claim 1, wherein said transform window for the length corresponding to the N samples before decimation has a length corresponding to N/(2^m) samples and is obtained by halving the sum of the (2^(m)n+(2^(m-1))-1-th sample and the (2^(m)n+(2^(m-1))-th sample.

3. The signal processing device according to claim 1, wherein said

preprocessing means produce the following signal from said N/(2^m) samples multiplied by said forward window;

first intermediate signal of N/(2^m) samples, of which n-th sample is obtained by inverting the polarity of the n+3N/(2^(m+2))-th said forward windowed sample for n between 0 and N/(2^(m+2))-1, and setting N/(2^(m+2))-th said forward windowed sample for n between N/(2^(m+2)) and N/(2^(m))-1 (n being an integer from 0 to N-1);

second intermediate signal of N/(2^(m) samples, of which n-th sample is obtained by subtracting N/(2^(m)-1-2n-th from 2n-th sample of said first intermediate signal ; and

complex signal for output, equivalent to the signal of which n-th sample is a product of exp(-2^(m+1)πjn/N) and a complex signal of which real part is 2n-th sample of said second intermediate signal and imaginary part is 2n+1-th sample of said second intermediate signal.

4. The signal processing device according to claim 1, wherein said postprocessing means produce the following signal from the N/(2^(m+2)) sample output complex signal of said transform processing means;

third intermediate signal, of which k-th sample is obtained by halving the sum of the k-th and the conjugate of N/(2^(m+2))-1-k-th sample of said output complex signal of said transform processing means (k being an integer from 0 to N/2-1);

fourth intermediate signal, of which k-th sample is obtained by dividing 2j and multiplying $\exp(-2^{(m+1)}\pi j(2k+1)/N)$ by the value subtracted conjugate of $N/(2^{(m+2)})-1$-k-th from k-th sample of said output complex signal of said transform processing means;

fifth intermediate signal, of which k-th sample is obtained by halving the sum of the $N/(2^{(m+2)})-1$-k-th and the conjugate k-th sample of said output complex signal of said transform processing means;

sixth intermediate signal, of which k-th sample is obtained by dividing 2j and multiplying $\exp(2^{(m+1)}\pi j(2k+1)/N)$ by the value subtracted conjugate of k-th from $N/(2^{(m+2)})-1$-k-th sample of said output complex signal of said transform processing means; and

complex signal for output, equivalent to the signal of which front half is obtained as the real part of the product of $\exp(-(2^{m})\pi j(2k+1)/(2N))$ and the sum of k-th sample of said third intermediate signal and k-th sample of fourth intermediate signal, and rear half is obtained as the real part of the product of $-j\exp((2^{m})\pi j(2k+1)/(2N))$ and the sum of k-th sample of said third intermediate signal and k-th sample of said fourth intermediate signal.

5. A signal processing device adapted to perform a linear inverse transform on a signal band-limited to $N/2^{(m+1)}$ samples out of N/2 samples and multiply the signal obtained by the linear inverse transform by an inverse transform window to produce $N/2^{(m+1)}$ independent signals, said device

comprising;

a preprocessing means for performing a predetermined preprocessing operation on the said band-limited signal;

a transform processing means for performing a processing operation equivalent to a fast Fourier transform on the output signal of said preprocessing means;

a postprocessing means for performing a predetermined postprocessing operation on the output signal of said transform processing means; and

the input signal and the output signals of said transform processing means being complex signals having a length of N/(2^(m+2)).

6. The signal processing device according to claim 5, wherein said preprocessing means produce the following signal from said band-limited N/(2^(m+1)) samples;

first intermediate signal, of which k-th sample is obtained by setting the 2k-th said band-limited sample for k between 0 and N/(2^(m+2))-1, and inverting the polarity of the N/(2^m)-1-2k-th said band-limited sample for k between N/(2^(m+2)) and N/(2^(m+1))-1 (k being an integer from 0 to N/2-1); and,

complex signal for output, equivalent to the signal of which k-th sample is a product of exp (-2^(m+2)πjn/N) and a complex signal of which real part is 2k-th sample of said first intermediate signal and imaginary part is 2k+1-th

sample of said first intermediate signal.

7. The signal processing device according to claim 5, wherein said postprocessing means produce the following signal from the N/(2^(m+2)) sample output complex signal of said transform processing means;

second intermediate signal, of which n-th sample is obtained by halving the sum of n-th and the conjugate of N/(2^(m+2))-1-n-th sample of said output complex signal of said transform processing means (n being an integer from 0 to N);

third intermediate signal, of which n-th sample is obtained by dividing 2j and multiplying exp(-2^(m+1)πj(2n+1)/N) by the value subtracted conjugate of N/(2^(m+1))-1-n-th from n-th sample of said output complex signal of said transform processing means;

fourth intermediate signal, of which n-th sample is obtained by halving the sum of the N/(2^(m+2))-1-n-th and the conjugate of the n-th sample of said output complex signal of said transform processing means;

fifth intermediate signal, of which n-th sample is obtained by dividing 2j and multiplying exp(-2^(m+1)πj(2n+1)/N) by the value subtracted conjugate of n-th from N/(2^(m+2))-1-n-th sample of said output complex signal of said transform processing means;

sixth intermediate signal, equivalent to the signal of which front half is obtained as the real part of the product of exp(-(2^(m+1))πj(2n+1)/(2N)) and

the sum of the n-th sample of said second intermediate signal and n-th sample of said third intermediate signal, and rear half is obtained as the real part of the product of $-j \exp((2^m)\pi j(2n+1)/(2N))$ and the sum of the n-th sample of said fourth intermediate signal and n-th sample of said fifth intermediate signal; and,

signal for output, equivalent to the signal of which n-th sample is obtained by the $n+N/(2^{(m+2)})$-th sample of said sixth intermediate signal for n between 0 and $N/(2^{(m+2)})-1$, inverting the polarity of the $3N/(2^{(m+2)})-1-n$-th sample of said sixth intermediate signal for n between $N/(2^{(m+2)})$ and $3N/(2^{(m+2)})-1$, and inverting the polarity of the $n-3N/(2^{(m+2)})$-th sample of said sixth intermediate signal for n between $3N/(2^{(m+2)})$ and $N/(2^m)-1$.

8. The signal processing device according to claim 5, wherein said transform window has a length corresponding to $N/(2^m)$ samples obtained by halving the sum of the $(2^m)n+(2^{(m-1)})-1$-th sample and the $(2^m)n+(2^{(m-1)})$-th sample for the length corresponding to the N samples without being subjected to any band-limit.

9. A signal processing device comprising:

a first transform means for decoding the first code string produced by coding the spectrum signal obtained by performing a direct modified discrete cosine transform on a time series signal, and transforming the spectrum signal obtained by the decoding into a time series signal by performing an inverse

modified discrete cosine transform;

a second transform means for transforming the time series signal output from said first transform means into a spectrum signal by performing a direct modified discrete cosine transform and coding the spectrum signal into a second code string; and

upon being allowed to make the signal band of said second code string narrower than that of said first code string, said first transform means performing the computations of the fast Fourier transform to be carried out for said inverse modified discrete cosine transform, using a tap length corresponding to said narrowed band.

10. A signal processing device comprising:

a first transform means for decoding the first code string produced by coding the spectrum signals obtained by performing a direct modified discrete cosine transform on each of the signals obtained by dividing a time series signal into a plurality of bands, transforming the spectrum signals obtained by the decoding into time series signals by performing an inverse modified discrete cosine transform and synthetically combining the bands; a second transform means for transforming the time series signal output from said first transform means into a spectrum signal by performing a direct modified discrete cosine transform and coding the spectrum signal into a second code string; and

upon being allowed to make specific ones of said signal bands of said second code string narrower than the corresponding ones of the signal bands of said first code string, said first transform means performing the computations of the fast Fourier transform to be carried out for said inverse modified discrete cosine transform, using a tap length corresponding to said narrowed bands.

11. The signal processing device according to claim 10, wherein

said first code string is formed by dividing the frequency band of the time series signal into octave sub-bands, transforming the signals of each sub-bands into a spectrum signal by means of modified discrete cosine transform, and encoding the obtained spectrum signal; and

said second transform means is adapted to divide the frequency band of the time series signal output from said first transform means into equal sub-bands and subsequently encoding the signals in the equal sub-bands.

12. The signal processing device according to claim 10, wherein

said first code string is formed by dividing the frequency band of the time series signal into equal sub-bands, transforming each of the signals having one of the sub-bands into a spectrum signal by means of modified discrete cosine transform, and encoding the obtained spectrum signal; and

said second transform means is adapted to divide frequency band of the time series signal output from said first transform means into octave sub-bands

and subsequently encoding the signals in the octave sub-bands.

13. A signal processing device comprising:

a first transform means for decoding the first code string produced by coding the spectrum signal obtained by performing a direct modified discrete cosine transform on a time series signal, and transforming the spectrum signal obtained by the decoding into a time series signal by performing an inverse modified discrete cosine transform;

a second transform means for transforming the time series signal output from said first transform means into a spectrum signal by performing a direct modified discrete cosine transform and coding the spectrum signal into a second code string; and

upon being allowed to make the signal band of said second code string narrower than that of said first code string, said second transform means performing the computations of the fast Fourier transform to be carried out for said direct modified discrete cosine transform, using a tap length corresponding to said narrowed band.

14. A signal processing device comprising:

a first transform means for decoding the first code string produced by coding the spectrum signals obtained by performing a direct modified discrete cosine transform on each of the signals obtained by dividing a time series signal into a plurality of bands, transforming the spectrum signals obtained by

the decoding into time series signals by performing an inverse modified discrete cosine transform and synthetically combining the bands; a second transform means for transforming the time series signal output from said first transform means into a spectrum signal by performing a direct modified discrete cosine transform and coding the spectrum signal into a second code string; and

upon being allowed to make specific ones of said signal bands of said second code string narrower than the corresponding ones of the signal bands of said first code string, said second transform means performing the computations of the fast Fourier transform to be carried out for said direct modified discrete cosine transform, using a tap length corresponding to said narrowed bands.

15. The signal processing device according to claim 14, wherein

said first code string is formed by dividing the frequency band of the time series signal into octave sub-bands, transforming the signals of each sub-bands into a spectrum signal by means of modified discrete cosine transform, and encoding the obtained spectrum signal; and

said second transform means is adapted to divide the frequency band of the time series signal output from said first transform means into equal sub-bands and subsequently encoding the signals in the equal sub-bands.

16. The signal processing device according to claim 14, wherein said

first code string is formed by dividing the frequency band of the time series signal into equal sub-bands, transforming each of the signals having one of the sub-bands into a spectrum signal by means of modified discrete cosine transform and encoding the obtained spectrum signal; and

said second transform means is adapted to divide frequency band of the time series signal output from said first transform means into octave sub-bands and subsequently encoding the signals in the octave sub-bands.

17. A signal processing method adapted to multiply the N/(2^m) samples obtained by decimating the N samples of a signal by a forward transform window and subsequently perform a linear forward transform on the obtained signal, said method comprising:

a preprocessing step of performing a predetermined preprocessing operation on the signal obtained by the multiplication using the multiplier of said forward transform window;

a transform processing step of performing a processing operation equivalent to a fast Fourier transform on the output signal of said preprocessing step;

a postprocessing step of performing a predetermined postprocessing operation on the output signal of said transform processing step; and

the input signal and the output signal of said transform processing step being complex signals having a length of N/(2^(m+2)).

18. The signal processing method according to claim 17, wherein said transform window for the length corresponding to the N samples before decimation has a length corresponding to N/(2^m) samples, and is obtained by halving the sum of the (2^(m)n+(2^(m-1))-1-th sample and the (2^m)n+(2^(m-1))-th sample.

19. The signal processing method according to claim 17, wherein said preprocessing step produce the following signal from said N/(2^m) samples multiplied by said forward window;

first intermediate signal of N/(2^m) samples, of which n-th sample is obtained by inverting the polarity of the n+3N/(2^(m+2))-th said forward windowed sample for n between 0 and N/(2^(m+2))-1, and setting N/(2^(m+2))-th said forward windowed sample for n between N/(2^(m+2)) and N/(2^(m))-1 (n being an integer from 0 to N-1);

second intermediate signal of N/(2^(m) samples, of which n-th sample is obtained by subtracting N/(2^(m)-1-2n-th from 2n-th sample of said first intermediate signal ; and

complex signal for output, equivalent to the signal of which n-th sample is a product of exp(-2^(m+1)πjn/N) and a complex signal of which real part is 2n-th sample of said second intermediate signal and imaginary part is 2n+1-th sample of said second intermediate signal.

20. The signal processing method according to claim 17, wherein said

postprocessing step produce the following signal from the N/(2^(m+2)) sample output complex signal of said transform processing step;

third intermediate signal, of which k-th sample is obtained by halving the sum of the k-th and the conjugate of N/(2^(m+2))-1-k-th sample of said output complex signal of said transform processing step (k being an integer from 0 to N/2-1);

fourth intermediate signal, of which k-th sample is obtained by dividing 2j and multiplying exp(-2^(m+1)πj(2k+1)/N) by the value subtracted conjugate of N/(2^(m+2))-1-k-th from k-th sample of said output complex signal of said transform processing step;

fifth intermediate signal, of which k-th sample is obtained by halving the sum of the N/(2^(m+2))-1-k-th and the conjugate k-th sample of said output complex signal of said transform processing step;

sixth intermediate signal, of which k-th sample is obtained by dividing 2j and multiplying exp(2^(m+1)πj(2k+1)/N) by the value subtracted conjugate of k-th from N/(2^(m+2))-1-k-th sample of said output complex signal of said transform processing step; and

complex signal for output, equivalent to the signal of which front half is obtained as the real part of the product of exp(-(2^m)πj(2k+1)/(2N)) and the sum of k-th sample of said third intermediate signal and k-th sample of fourth intermediate signal, and rear half is obtained as the real part of the product of

$-j\ \exp((2^{m})\pi j(2k+1)/(2N))$ and the sum of k-th sample of said third intermediate signal and k-th sample of said fourth intermediate signal.

21. A signal processing method adapted to perform a linear inverse transform on a signal band-limited to $N/2^{(m+1)}$ samples out of $N/2$ samples and multiply the signal obtained by the linear inverse transform by an inverse transform window to produce $N/2^{(m+1)}$ independent signals, said method comprising;

a preprocessing step of performing a predetermined preprocessing operation on the said band-limited signal;

a transform processing step of performing a processing operation equivalent to a fast Fourier transform on the output signal of said preprocessing step;

a postprocessing step of performing a predetermined postprocessing operation on the output signal of said transform processing step; and

the input signal and the output signals of said transform processing step being complex signals having a length of $N/(2^{(m+2)})$.

22. The signal processing method according to claim 21, wherein said preprocessing step produce the following signal from said band-limited $N/(2^{(m+1)})$ samples;

first intermediate signal, of which k-th sample is obtained by setting the 2k-th said band-limited sample for k between 0 and $N/(2^{(m+2)})-1$, and

inverting the polarity of the N/(2^m)-1-2k-th said band-limited sample for k between N/(2^(m+2)) and N/(2^(m+1))-1 (k being an integer from 0 to N/2-1); and,

complex signal for output, equivalent to the signal of which k-th sample is a product of exp (-2^(m+2)πjn/N) and a complex signal of which real part is 2k-th sample of said first intermediate signal and imaginary part is 2k+1-th sample of said first intermediate signal.

23. The signal processing method according to claim 21, wherein said postprocessing step produce the following signal from the N/(2^(m+2)) sample output complex signal of said transform processing step;

second intermediate signal, of which n-th sample is obtained by halving the sum of n-th and the conjugate of N/(2^(m+2))-1-n-th sample of said output complex signal of said transform processing step (n being an integer from 0 to N);

third intermediate signal, of which n-th sample is obtained by dividing 2j and multiplying exp(-2^(m+1)πj(2n+1)/N) by the value subtracted conjugate of N/(2^(m+1))-1-n-th from n-th sample of said output complex signal of said transform processing step;

fourth intermediate signal, of which n-th sample is obtained by halving the sum of the N/(2^(m+2))-1-n-th and the conjugate of the n-th sample of said output complex signal of said transform processing step;

fifth intermediate signal, of which n-th sample is obtained by dividing 2j and multiplying exp(-2^(m+1)πj(2n+1)/N) by the value subtracted conjugate of n-th from N/(2^(m+2))-1-n-th sample of said output complex signal of said transform processing step;

sixth intermediate signal, equivalent to the signal of which front half is obtained as the real part of the product of exp(-(2^(m+1))πj(2n+1)/(2N)) and the sum of the n-th sample of said second intermediate signal and n-th sample of said third intermediate signal, and rear half is obtained as the real part of the product of -j exp((2^m)πj(2n+1)/(2N)) and the sum of the n-th sample of said fourth intermediate signal and n-th sample of said fifth intermediate signal; and,

signal for output, equivalent to the signal of which n-th sample is obtained by the n+N/(2^(m+2))-th sample of said sixth intermediate signal for n between 0 and N/(2^(m+2))-1, inverting the polarity of the 3N/ (2^(m+2))-1-n-th sample of said sixth intermediate signal for n between N/(2^(m+2)) and 3N/(2^(m+2))-1, and inverting the polarity of the n-3N/(2^(m+2))-th sample of said sixth intermediate signal for n between 3N/(2^(m+2)) and N/(2^m)-1.

24. The signal processing method according to claim 21, wherein said transform window has a length corresponding to N/(2^m) samples obtained by halving the sum of the (2^(m)n+(2^(m-1))-1-th sample and the (2^m)n+(2^(m-1))-th sample for the length corresponding to the N samples without being

subjected to any band-limit.

25. A signal processing method comprising:

a first transform step of decoding the first code string produced by coding the spectrum signal obtained by performing a direct modified discrete cosine transform on a time series signal, and transforming the spectrum signal obtained by the decoding into a time series signal by performing an inverse modified discrete cosine transform;

a second transform step of transforming the time series signal output from said first transform step into a spectrum signal by performing a direct modified discrete cosine transform and coding the spectrum signal into a second code string; and

upon being allowed to make the signal band of said second code string narrower than that of said first code string, the computations of the fast Fourier transform to be carried out for said inverse modified discrete cosine transform being performed in said first transform step, using a tap length corresponding to said narrowed band.

26. A signal processing method comprising:

a first transform step of decoding the first code string produced by coding the spectrum signals obtained by performing a direct modified discrete cosine transform on each of the signals obtained by dividing a time series signal into a plurality of bands, transforming the spectrum signals obtained by

the decoding into time series signals by performing an inverse modified discrete cosine transform and synthetically combining the bands; a second transform step of transforming the time series signal output from said first transform step into a spectrum signal by performing a direct modified discrete cosine transform and coding the spectrum signal into a second code string; and

upon being allowed to make specific ones of said signal bands of said second code string narrower than the corresponding ones of the signal bands of said first code string, the computations of the fast Fourier transform to be carried out for said inverse modified discrete cosine transform being performed in said first transform step, using a tap length corresponding to said narrowed bands.

27. The signal processing method according to claim 26, wherein

said first code string is formed by dividing the frequency band of the time series signal into octave sub-bands, transforming the signals of each sub-bands into a spectrum signal by means of modified discrete cosine transform, and encoding the obtained spectrum signal; and

said second transform means is adapted to divide the frequency band of the time series signal output from said first transform means into equal sub-bands and subsequently encoding the signals in the equal sub-bands.

28. The signal processing method according to claim 26, wherein said

first code string is formed by dividing the frequency band of the time series signal into equal sub-bands, transforming each of the signals having one of the sub-bands into a spectrum signal by means of modified discrete cosine transform, and encoding the obtained spectrum signal; and

said second transform means is adapted to divide frequency band of the time series signal output from said first transform means into octave sub-bands and subsequently encoding the signals in the octave sub-bands.

29. A signal processing method comprising:

a first transform step of decoding the first code string produced by coding the spectrum signal obtained by performing a direct modified discrete cosine transform on a time series signal, and transforming the spectrum signal obtained by the decoding into a time series signal by performing an inverse modified discrete cosine transform;

a second transform step of transforming the time series signal output from said first transform step into a spectrum signal by performing a direct modified discrete cosine transform and coding the spectrum signal into a second code string; and

upon being allowed to make the signal band of said second code string narrower than that of said first code string, the computations of the fast Fourier transform to be carried out for said direct modified discrete cosine transform being performed in said second transform step, using a tap length

corresponding to said narrowed band.

30. A signal processing method comprising:

a first transform step of decoding the first code string produced by coding the spectrum signals obtained by performing a direct modified discrete cosine transform on each of the signals obtained by dividing a time series signal into a plurality of bands, transforming the spectrum signals obtained by the decoding into time series signals by performing an inverse modified discrete cosine transform and synthetically combining the bands; a second transform step of transforming the time series signal output from said first transform step into a spectrum signal by performing a direct modified discrete cosine transform and coding the spectrum signal into a second code string; and

upon being allowed to make specific ones of said signal bands of said second code string narrower than the corresponding ones of the signal bands of said first code string, the computations of the fast Fourier transform to be carried out for said direct modified discrete cosine transform being performed in said second transform step, using a tap length corresponding to said narrowed bands.

31. The signal processing method according to claim 30, wherein

said first code string is formed by dividing the frequency band of the time series signal into octave sub-bands, transforming the signals of each sub-

bands into a spectrum signal by means of modified discrete cosine transform and encoding the obtained spectrum signal; and

said second transform step is adapted to divide the frequency band of the time series signal output from said first transform means into equal sub-bands and subsequently encoding the signals in the equal sub-bands.

32. The signal processing method according to claim 30, wherein

said first code string is formed by dividing the frequency band of the time series signal into equal sub-bands, transforming each of the signals having one of the sub-bands into a spectrum signal by means of modified discrete cosine transform and encoding the obtained spectrum signal; and

said second transform step is adapted to divide frequency band of the time series signal output from said first transform means into octave sub-bands and subsequently encoding the signals in the octave sub-bands.